

**SPECIFICATION**

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, Thomas L. Welsh , a resident of Newcomerstown, County of Tuscarawas, and State of Ohio, Glenn E. Burket, a resident of Dover, County of Tuscarawas, and State of Ohio, and Joseph F. Dick, a resident of New Philadelphia, County of Tuscarawas, and State of Ohio, all are citizens of the United States of America and have invented certain new and useful improvements in a

**CONNECTOR AND METHOD OF MANUFACTURE**

of which the following is a specification.

## CONNECTOR AND METHOD OF MANUFACTURE

### TECHNICAL FIELD

This invention relates to a connector for use in fluid and vapor transmissions that  
 5 can be quickly connected and disconnected from a tubular conduit but which can provide  
 an effective seal between the connector and the tubular conduit. More particularly, this  
 invention relates to a connector formed of a single material surrounding a seal ring which  
 limits leakage through the seal between the connector and the conduit. Most particularly,  
 this invention relates to a connector and its method of manufacture which allows the  
 10 connector to be molded around the seal ring without requiring further assembly to retain  
 or load the seal ring.

### BACKGROUND OF THE INVENTION

In many industries connectors are used to provide connections between fluid  
 15 carrying conduits. For ease of use, these connectors are designed to allow quick  
 connection and disconnection. The quick disconnection and connection feature allows  
 such connectors to be used in confined spaces where more cumbersome connectors would  
 be prohibited.

In general, these connectors have either a one-piece or two-piece configuration.  
 20 Those having a one-piece configuration are generally molded of one type of plastic or  
 organic polymer material, and conduits are attached in a bayonet fashion to barbed ends  
 of the connector. In this configuration, sealing is effected at the interface between this  
 plastic or inorganic polymer material and the material of the conduit. The one piece  
 connector is attractive because it may be manufactured in a single molding step making  
 25 the production of such connectors relatively inexpensive. Unfortunately, the interfacing  
 or the conduit and connector does not provide a reliable seal.

As a result, two-piece configurations using a seal ring between the conduit and  
 connector have been developed. In the two piece configuration, a seal ring contained  
 between either of the two-pieces have been used to provide better sealing. Instead of  
 30 relying on interface between the connector and the conduit, the seal ring provides

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effective protection against leakage. However, when compared to the manufacturing process of a one-piece configuration, the manufacturing process of the two-piece configuration is quite difficult.

5 In one known manufacturing process, three parts, namely, a connector body, a seal ring retainer, and a seal ring are manufactured separately. In this process the connector body and retainer are separately formed. Then, the seal ring is inserted into the connector body and the seal ring retainer is next inserted to load and hold the seal ring in the proper location within the connector body. A second process utilizes a seal ring and an inner ring placed on a mandrel which is inserted into an injection mold. In this process, the connector body part is molded around the seal ring and the inner ring. In each case, a separate assembly process is necessary to locate and load the seal ring. Consequently, the manufacturing of the two-piece configuration is more difficult, time consuming, and expensive to manufacture than the one-piece configurations. Overall, each configuration, one and two pieces, has inherent trade-offs. The one-piece design sacrifices sealing ability for ease of manufacture, and the two-piece design sacrifices ease of manufacture for improved sealing ability.

Consequently, there is a need for a cost-effective connector that provides a more reliable seal, relative to existing one piece connectors.

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### SUMMARY OF THE INVENTION

In general the present invention provides a connector including, a hollow member having an open first end and an open second end joined by a bore extending through the body having a first bore section and a second bore section that is stepwise reduced from the first bore section creating an annular shoulder therebetween, the first bore section tapering inwardly from the shoulder toward a third bore section, a sealing member receiver integrally formed into the connector and located within the second bore section near the third bore section, and a sealing member seated within the sealing member receiver and at least partially protruding inwardly into the second bore section.

25 The present invention further provides a connector including, a hollow member having a first open end and a second open end joined by a bore, the member defining a

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sealing member receiver housing an integrally assembled sealing member, wherein the sealing member receiver is adapted to compress the sealing member such that a portion of the sealing member protrudes into the bore, and at least one conduit retaining assembly located at one of the ends.

5 The present invention further provides a method of manufacturing a connector including, providing a mold, the mold defining a cavity and an insert assembly located within the cavity, providing a sealing member within the mold contacting the insert assembly and partially exposed to the cavity, compressing the sealing member such that contacts between the insert assembly and sealing member is maintained as the connector  
10 is molded, and providing molten plastic material into the mold cavity to form the connector.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially sectioned side elevational view of a connector according to the  
15 concepts of the present invention shown with a male end form inserted therein depicting details of the connector bore and sealing of the male end form within the connector;

Fig. 2 is front sectional view taken along line 2-2 in Fig. 1 of a connector according to the present invention depicting details of the first end of the connector including details of a retaining clip used to secure the male end form within the first end  
20 of the connector;

Fig. 3 is fragmented sectional side elevational view of a connector according to the present invention depicting details of the second end of the connector shown with an optional sealing member located thereon;

Fig. 4 is a plan view of a connector according to the present invention depicting  
25 details of first and second retaining assemblies located at opposite ends of the connector;

Fig. 5 is a left side elevational view of a connector according to the present invention with an internal seal shown in hidden lines;

Fig. 6 is an enlarged front elevational view of a lock ring according to the present invention with portions of the connectors schematically shown;

30 Fig. 7 is a partially sectioned side elevational view of an alternative embodiment

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of the present invention depicting details of an elbow-shaped connector;

Fig. 8 is a partially sectioned front elevational view of the connector depicted in Fig. 7 showing further details of the elbow-shaped connector according to the present invention;

5 Fig. 9 is a partially schematic sectional view of a connector and die according to the present invention depicting a portion of the method of forming a connector according to the present invention;

Fig. 10 is a partially schematic sectional view of a connector and die similar to that depicted in Fig. 9 shown with the die closed and the sealing member compressed;

10 Fig. 11 is a partially schematic sectional view similar to Fig. 10 with the mold open depicting the formed connector located on an insert assembly; and

Fig. 12 is a partially schematic sectional view similar to Fig. 11 depicting ejection of the connector from the mold.

#### 15 PREFERRED EMBODIMENTS FOR CARRYING OUT THE INVENTION

A first embodiment of the connector according to the concepts of the present invention as indicated generally be the numeral 10, and is shown particularly in Figs. 1-6. Connector 10 generally is a hollow member having an open first end 11 and an open second end 12 joined by a bore 13 extending through the body 14 of connector 10. In the  
20 embodiment shown, the bore 13 is divided into a first tubular section 15 and a second tubular section 16 coaxially oriented with respect to each other. First and second tubular sections 15, 16 may be of the same diameter or different diameters as shown. As best shown in Fig. 1, first section 15 is of a larger diameter than second section 16 and includes a series of step-like reductions in the diameter of first section 15, as described  
25 more completely below.

The body 14 defines a series of four sections of differing diameter. Near the end 11, the first tubular section 15 defines a first bore section 21. A second bore section 22 is defined adjacent the first bore section 21 and is formed by an initial step inwardly of the first tubular section 15 defining an annular shoulder 24. From shoulder 24 the second  
30 bore section 22 has an inwardly sloping surface S that transcends a gradual decrease in

diameter toward the third bore section 23. It will be appreciated that a stepwise reduction of diameter may be performed as an alternative to a sloping or curved gradual decrease. At the third bore section 23 the interior surface of first tubular section 15 undergoes another step decrease in diameter to the third bore section 23 defining a second annular shoulder or flange 25. Flange 25 has an inner diameter corresponding to the diameter of bore section 23 and an outer diameter corresponding approximately to the diameter of bore section 22. These diameters are closely toleranced such that a sealing relationship between a male end form F and the bore section 23 is maintained, as will be described hereinbelow.

As previously mentioned, the second tubular section 16 is of a lesser diameter than first tubular section 15 and accordingly, the bore fourth section 26 formed in the second tubular section 16 is of a lesser diameter than the third bore section 23 resulting in an annular shoulder 27 near the boundary of the two sections 15, 16. Overall, in the embodiment shown, the bore 13 undergoes a stepped reduction in diameter from the first opening 11 to the exit opening or second opening 12.

The first tubular section 15 is further provided with a sealing member receiver, generally indicated by the numeral 30, which may be an annular recess 31 generally having opposing shoulders 33 between which a sealing member, generally indicated by the numeral 35, is seated. The sealing member 35 may be any of a number of commercially available devices including an elastomeric O-ring, as shown. The sealing member receiver 30 is located adjacent the flange 25. The close tolerancing of the bore section diameters and flange 25 effectively control the seal offered by the sealing member 35 to ensure a good seal between the male end form F and sealing member 35. Since only the diameters ahead of the sealing member need to be closely toleranced, the bore section 22 behind sealing member 35, may be enlarged to accommodate the retraction of a pin assembly 215 used in the molding of connector 10 (Figs. 9-12).

To secure tubular members, such as conduits C or male end form F, to the connector 10, each of the first and second ends 11, 12 may be provided with a retainer assembly, generally indicated by the numeral 40. Retainer assembly 40 may be of a latch or clip-type retaining assembly, generally indicated by the numeral 45, and employed at

the first end 11 of the connector 10. One such retainer 45 is described in U.S. Patent No. 5,799,986 and which is incorporated herein by reference for whatever details are necessary to understand the present invention. To accommodate the latch retaining assembly 45, connector 10 is formed with a latching end, indicated generally by the numeral 46, formed adjacent open end 11. Latching end 46 includes a cylindrical shaped front housing 47 formed with a stepped bore 48. Housing 47 may have various other surface shapes, including an enlarged diameter front cylindrical portion 18 and a reduced diameter cylindrical rearward portion adjacent thereto. A pair of similar opposed apertures 49 are formed in the reduced diameter portion and have an arcuate shape for receiving a retaining clip, generally indicated by the numeral 50, therein. Each aperture has an arcuate length of approximately  $115^\circ$  and are separated from each other by diametrically opposed arcuate sections of housing 47 which have parallel spaced inner surfaces. The arcuate sections each have an arcuate length held for approximately  $65^\circ$ . The sections secure clip 50 within housing 47, when the clip 50 is in an inserted position therein, as shown in Figs. 1 and 2 and described further below.

Clip 50 may be a rigid one piece member, preferably molded of a high strength plastic material. The clip 50 includes a pair of diametrically opposed arcuate members 51, 52, which are connected by spaced generally parallel sides 53. The end members 51, 52 and sides 53 form an elongated inner opening 54. A guide tab 55 is formed integrally with the leading end member 52 and extended outwardly in stepped relationship therefrom. End members 51, 52 and sides 53 form a relatively rigid member 57 having legs 58, which expand and contract to capture male end form F therebetween.

A pair of curved flexible fingers 59 extend outwardly from end 51 and include a partially circular nub 60 on an inner surface adjacent the extended fingers 59. Two pairs of partially circular shaped recesses 61 are formed at the junction of each finger 59 and end member 51 to provide increased flexibility between the fingers 59 and the end member 51. A chamfered surface 65 is formed in the front inner edge 64 of clip 50 to allow male end form F to slidably pass therethrough, as discussed further below. As shown in Fig. 6, sides 53 of clip 50 have generally flat outer edges 66, which extend parallel to each other. Furthermore, elongated inner opening 54 includes a reduced

diameter arcuate portion at 67 adjacent arcuate end 64, which communicates with a larger diameter generally circular center portion at 68, which merges into a slotted portion at 69, which terminates at end member 51.

Referring to Fig. 1, male end form F is shown seated within inner opening 54. Conduit C shown is a mono-wall tube, although it is readily understood that it could be a multiple-wall member. Male end form F can be slidably inserted easily into opening 54 by applying a manual force thereto in the axial inward direction, where it forms a fluid tight seal with the sealing member 35 and is locked in position by the retainer clip 50. Thus, no additional attachments means of any kind is required to secure male end form F to connector 10.

The male end form F is installed easily within the open end of connector 10 by first inserting clip 50 into apertures 49 of the front housing 47 of latch end 46. The thickness of the end members 51, 52 and sides 53 is just slightly less than the width of apertures 49, and the distance between the outer flat edges 66 of side 53 is slightly less than the diametric distance between the parallel inner surfaces of apertures 49, to permit clip 50 to be slidably inserted through the apertures 49 into the position shown in Fig. 4. When inserting clip 50 through apertures 49, tab 55 will move through a pair of diametrically opposed and aligned guide channels 70 formed in the cylindrical portion of the housing 47. The guide tab 55 ensures that the clip 50 can only be installed so the chamfered surface 65 faces outwardly for receiving the tapered end of the tubular conduit when inserted into the connector 10. However, it is readily understood that the clip 50 can be inserted from either direction into the connector 10 by the formation of a pair of opposed channels 70. However, regardless of which direction the clip 50 is inserted through the aperture, tab 55 ensures that the chamfered surfaces 65 always faces outwardly for receiving the tapered end E of male end form F.

To lock the male end form F within the connector, clip 50 is forced inward so that the enlarged generally circular center portion 68 of elongated opening is coaxial with open end 11 of connector 10. This enables annular latching flange 75, which has a diameter approximately equal to that of central portion, to pass therethrough with a generally tight sliding fit, until end portion E is seated within the bores of inner and outer



members and in a fluid sealing engagement with sealing member 35, as shown in Fig. 1. Upon the release of force on end member of clip 50, the flexibility of fingers 59 will bias the clip 50 to the locked position of Fig. 2, wherein the smaller reduced diameter portion 67 of inner opening 54 leans into engagement with the male end form F and behind annular latching projection or flange 75 to lock the male end form F therein. To remove the male end form F from within the connector 10, the reverse operation is performed. Specifically, force is reapplied to end member 51, depressing fingers 59 with nubs 60 moving along surfaces providing a camming action therebetween, enabling the male end form F to be pulled from connector 10, whereby annular latching flange 75 moves through the complimentary shape and equal diameter of central portion 68 of clip opening 54.

Flexible tabs 56 snap behind end of housing 47 when clip 50 is in the locked position with tubular male end form F, to securely retain the clip 50 in the locked position. End member 51 is merely pushed inwardly, to release engagement with edge 70 permitting clip 50 to be moved to the unlocked position where enlarged central portion 68 aligns with the connector bore.

As an alternative to using a latch form retaining assembly, as described above, to retain a conduit C, a barbed retaining assembly, generally indicated by the numeral 80, and shown formed on the second tubular section 16 of connector 10, may be used to secure a flexible tubular member or generally a conduit C to connector 10. In the barbed assembly 80, a plurality of outwardly extending annular flanges 82 are provided. These flanges 82 have a positively sloped annular leading face 83, which causes expansion of the conduit as it is forced over retainer assembly 80 in a bayonet-type fashion. Preferably, the leading face 83 is molded such that it does not have a parting line reducing the likelihood of damage to the conduit C. The rear faces 88 of the flanges 82 are disposed to resist movement of the conduit in an axially outward direction. As will be described more completely below, a pin assembly 215 is used to position sealing member 35 within a mold cavity 204 used to form the connector 10. In this manner, the sealing member 35 may be introduced prior to the molding of the connector and thus be formed integrally with the connector 10. In this way the steps of subsequent assembly and

insertion or formation sealing member retaining inserts are obviated. This further allows the body 14 to be formed of a single material. To improve the seal at the barbed retaining assembly 80, a second seal member receiver, generally indicated by the numeral 90 may be formed on the second tubular section 16 to hold a second sealing member 91. In the embodiment shown, a recess 92 and an annular retaining flange 93 are formed proximate one of the barbed flanges 82 and spaced therefrom to provide a clearance for the second sealing member 91, which in this case is an elastomeric O-ring. Receiver recess 92 may be radiused such that it closely fits a circular cross-section sealing member 91. Retaining flange 93 may be provided with a positively sloped top surface similar to that of barbs 82 that facilitates passage of the conduit C over seal receiver 90. A portion of the sealing member 91 extends radially outwardly of the periphery of each of the flanges 82, to effect sealing contact with the conduit attached at the second end 16 of the connector 10.

An alternative embodiment of the present invention is depicted in Figs. 7-8 and generally indicated by the numeral 110. In this embodiment, the connector 110 is essentially identical to the previously described connector 10, using like numerals on like parts, with the exception that it is configured in the shape of an elbow, where the first tubular section 15 is disposed at a right angle to the second tubular section 16. Due to the orientation of the first tubular section and second tubular section, an angular flange 195 extends from the interior corner 196 within the bore 113 to the exterior corner 197 of the bore 113 to provide a stop for the pin assembly 215. It will be appreciated that if pin assembly 215 were fully inserted its bore would abut that interior surface of the connector 110, causing a restriction of fluid flow. By providing flange 195 fluid communication between the male end form F and the tubular section 27 is preserved. With this in mind, the male end form F may be provided with an angular tip to effect a close fit of the male end form F within the bore 113.

If desired, multiple sealing members 35, 90 may be utilized to further improve the sealing connection between the connector 10, 110 and tubular members without affecting the concepts of the present invention.

In accordance with another feature of the invention, a connector 10 is manufactured by an improved method, as shown particularly in Figs. 9-12. In the

improved method, the sealing member 35 is integrally formed with the connector 10.

To manufacture a connector 10, a mold assembly, generally indicated by the numeral 200 in Figs. 9-12 may be used. It will be appreciated that connector 110 may be formed using the following method with slight modification of the mold assembly 200.

5 In Fig. 9, the mold assembly 200 is shown open and includes a first die portion 201 a second die portion 202 and a third die portion 203 which defines a cavity 204 shaped to form the exterior features of a connector. An insert assembly, generally indicated by the numeral 205 defines a portion of the interior features of the connector. In the embodiment shown, a portion of the bore 13 of connector 10 is formed around a mandrel  
10 206 supported on the third die-sections 203. As shown, the tip of a barbed retainer 80 may be defined in its entirety within third die section 203 to prevent the formation of a parting line on the leading surface 83 of retainer 80.

Returning to the insert assembly 205, the bore sections within connector 10 are formed by corresponding stepped surfaces 211, 212, and 213 on the insert assembly 205.  
15 Corresponding to the bore section 21, a generally cylindrical insert section 211 is provided adjacent a base section 210 to form the cylindrical bore section 21. Insert section 212 is stepped radially inward from section 211 to form flange 24 of connector 10. Section 212 may taper inwardly from section 211 defining a generally frustoconical section to create the sloped surface S. The tapered section 212 facilitates ejection of the  
20 connector from the mold. Sections 211 and 212 are made hollow and define a bore that receives a moveable pin assembly 215. The pin assembly 215 may be attached to the insert assembly 205 by a screw or other fastener 216, as shown. A first portion 217 of the pin assembly 215 is sized smaller than the bore defined by the first and second insert sections 211, 212 to provide clearance for a biasing member such as coil spring 218  
25 shown. A second portion 219 of pin assembly 215 is received on the first portion 217 and has a diameter corresponding substantially to that of the bore defined by first and second sections 211, 212 of insert assembly 205 but sufficiently reduced to allow sliding movement within the bore. When the spring 218 is compressed, die wall 214 acts as a step for pin assembly 215, as described more completely below. A radially extending  
30 annular flange 220 divides the second portion 219 into a sealing member receiving

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portion 221 and mandrel receiving portion 222. Sealing member 35 is located on sealing member receiving portion 221 and abuts flange 220. The mandrel receiving portion 222 is provided with a recess or bore 223 adapted to receive at least a portion of mandrel 206 when the die 200 is closed.

5 As shown in Fig. 9, the sealing member 35 is initially spaced from the edge 224 of insert assembly 205 by a suitable clearance 225 to allow movement of the pin assembly 215, as will be described below.

When the die is closed (Fig. 10), the sections 201, 202 cooperate to form a cavity 204 corresponding to the connector 10. The mandrel 206 is axially inserted into the first 10 and second portions 201, 202 and seated within a portion 223 of the pin assembly 215. The insertion of mandrel 206 urges the pin assembly axially inward toward the base portion 210 of the insert assembly 205 compressing the spring 218. As the spring 218 is compressed, the sealing member 35 is brought into an engagement with the end 224 of the second insert section 212. As the mandrel 206 continues to move inwardly to a 15 selected position, the sealing member 35 is compressed to a predetermined extent between the flange 220 and end 224 to prevent molten plastic material at injection pressures from being blown by the sealing member 35. The molten plastic material fills the mold 200 to form connector 10. Further, the material defines the sealing member receiver 30 around the sealing member 35 holding it in a loaded condition.

20 Once injection is complete, the mandrel 206 opens first followed by opening of the first and second mold sections 201, 202 (Fig. 11). Ejection pins 230 inserted through suitable receivers 231 formed in the base 210 of insert assembly 205 to push the completed connector 10 from the insert assembly 205 (Fig. 12). As the connector 10 is ejected, the pin assembly 215 moves with the connector 10 for a short distance easing the 25 release of the connector 10 from the insert assembly 205 by essentially releasing the connector 10 in two steps. The two step opening further provides additional clearance for the sealing ridge 220 to compress the sealing member 35 allowing the sealing member to pass over the ridge 220. Thus, the completed connector with integrally assembled sealing member 35 is ejected from the mold. After which, the ejector pins 230 retract and 30 the molding process may begin anew.

Thus, it should be evident that the connector 10, 110 and method of manufacturing the same disclosed herein carries out one or more of the objects of the present invention set forth above and otherwise constitutes an advantageous contribution to the art. As will be apparent to persons skilled in the art, modifications can be made to the embodiments disclosed herein without departing from the spirit of the invention, the scope of the invention herein being limited solely by the scope of the attached claims.

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